How Ultimatum Offers Emerge – A Study in Bounded Rationality*–

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Abstract

The general framework of decision emergence (Güth, 2000a) is applied to the specific decision task of a proposer in ultimatum bargaining, i.e. to choosing how much the responder should be offered. For this purpose the "Master Module" as well as its submodules "New Problem Solver", "Adaptation Procedure", and "Learning" have to be specified for the task at hand. This illustrates the applicability of the general framework of boundedly rational decision emergence.

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1. Introduction

Assume that a positive monetary amount (the "pie") has to be allocated among two parties. According to ultimatum bargaining first one party (the "proposer") decides how much it offers to the other party (the "responder"). The responder can either accept the offer, meaning that the residual is collected by the proposer, or have no agreement at all, meaning that both parties get nothing. If both parties are only interested in their own monetary payoff, the responder would accept every positive offer and, this being anticipated, would receive at most the smallest positive offer. Thus in spite of his veto power the responder is left essentially empty handed, regardless of the size of the pie.

When such a game is played just once (or repeatedly with ever changing partners) we speak of an ultimatum (bargaining) experiment (see the surveys by Thaler, 1988, Güth and Tietz, 1990, Camerer and Thaler, 1995, Güth, 1995, and Roth, 1995). Their results provoked many attempts (Bolton, 1991, Rabin, 1993, Kirchsteiger, 1994, Bolton and Ockenfels, 1999, Fehr and Schmidt, 1999, Güth, 2000b) to explain striking experimental observations like rejection of considerable but unfair offers and proposer fairness who often offer half of the pie to the responder.

Some of the explanations do not question (common knowledge of) rationality. To account for the experimental findings they, however, rely on a richer motivational structure. They go beyond purely monetary motives by including envy (Kirchsteiger, 1994), inclinations to reciprocate (Rabin, 1993), or inequality aversion (Bolton, 1991, Bolton and Ockenfels, 1999, Fehr and Schmidt, 1999). Such ideas can, of course, be implemented in various ways depending, for instance, on the functional form in which incentives are incorporated (e.g. in general ways like in Bolton and Ockenfels, 1999, or as additively separable motives like in Fehr and Schmidt, 1999).

All aforementioned approaches stick to explaining observed behavior as the outcome of future directed rational choices. A completely different type of explanations deny any forward looking deliberation by simply focusing on behavioral

adaptation in the light of past success (in bargaining with other partners). If, for instance, proposers learn more quickly to avoid unfair and often rejected offers than responders learn to accept such offers, fair offers can be the result of adaptation (Gale, Binmore, and Samuelson, 1995). If proposers and responders are drawn from the same population, rejecting a very low offer does not cost very much, but hurts the proposer considerably. In a small population or small group of interacting partners (where relative success can be increased by hurting other(s) more than oneself) one thus may improve one's relative position by rejecting low offers (Huck and Oechssler, 1999). For similar reasons reinforcement learning (Bush and Mosteller, 1955) can bring about rather fair offers (Roth and Erev, 1995). Explanations like the previously mentioned do not assume that proposers engage in forward looking deliberations.

Models of bounded rationality pay attention to cognitive as well as to motivational and emotional limitations of human decision makers who nevertheless aim at reasonable decisions within such limitations. Cognitive efforts are reasonable if their costs, which usually depend on one's analytic skills and education, are acceptable in view of the decision problem at hand. The general framework of boundedly rational decision emergence (Güth, 2000a) that will be applied here views choice making as a dynamic process. It starts with searching one's behavioral repertoire for former experiences and by updating them appropriately if possible and assumes that one cognitively represents one's decision environment in more complex forms only when needed. This general framework is basically an attempt to combine several ideas and facts about human decision making in a consistent way while rejecting others. Instead of readily available evaluations of choice alternatives (like in utility or prospect theory, Kahneman and Tversky, 1979) evaluations have to be derived by some cumbersome cognitive process. This does not deny, however, that mature behavior might appear as if being generated by such evaluation functions.

The dynamics of deliberation can only be partly supported by empirical observations. Where this is impossible, speculative hypotheses or conjectures have to be substituted by stylized facts. Another weakness is that such a frame does not provide a readily available algorithm for generating choices. This latter weakness can

be partly avoided if one does not consider all choice problems, but concentrates on a specific decision task like choosing an ultimatum offer. There is a good chance to experimentally test some of the still insufficiently invalidated hypotheses and to develop an empirically supported picture how ultimatum offers emerge.

In section 2 we describe ultimatum bargaining and its typical experimental results. Section 3 outlines the general approach before specifying its various modules in the main section 4. The Conclusions (section 5) discuss the missing evidence and relate our approach to the earlier ad hoc-explanation of proposer behavior (Güth, 2000b).

2. Ultimatum bargaining experiments

Two parties, named proposer and responder, can share just once a positive monetary amount, the so-called "pie". By choosing the monetary unit appropriately one can always see to it that the size of the pie is 1, i.e. there is no difference between one's absolute and relative share of the pie. As suggested by its name ultimatum bargaining assumes that one party (the proposer) can confront the other party (the responder) with an ultimatum offer o with $0 \leq o \leq 1$. If the responder accepts o, his monetary payoff is o whereas the proposer receives the remaining share $1 - o$. If the responder, however, rejects the offer o, both receive nothing.

When both parties are only interested in their monetary payoff, a rational responder will accept all positive offers o so that a rational proposer will either offer only the smallest positive share (in case of indivisibilities and a sufficiently high rejection probability of $o = 0$) or $o = 0$. Thus once repeated elimination of dominated strategies implies in either case an extreme distribution according to which the proposer gets (nearly) all the pie. There is ample evidence (see the surveys cited above), however, that this recommendation is very bad advice.

The main findings of hundreds of ultimatum bargaining experiments are that

- there is considerable heterogeneity in both proposer and responder behavior,
- low offers $o < 1/4$ are rarely accepted,
- the modal offer, at least of inexperienced proposers, is the equal split,
- most offers o lie in the range $1/3 \leq o \leq 1/2$,
- neither experience nor differences in culture lead to qualitatively different results from those listed before.

The robustness of these observations is demonstrated by performing so-called high stake-experiments (typically in poor countries), by parallel experiments in different countries, and by framing the experiments differently (see Roth, 1995, for a survey). This does not mean that the stylized facts cannot be questioned at all. For instance, after auctioning of the proposer and responder role before letting the two auction winners play the ultimatum game, Güth and Tietz (1986) hardly ever observed an equal split-offer $o = 1/2$. Since proposers had to pay a much higher price for obtaining their position, the equal split apparently lost its attraction.

3. Boundedly rational decision emergence

According to concepts of bounded rationality people do not optimize, but satisfice (Simon, 1976) and form as well as adjust their aspirations in the light of own or others' experiences (Sauermann and Selten, 1962, see also Selten, 1998). Other ideas like learning theories as mentioned above are rather unconnected and it remains doubtful whether or not the various concepts are mutually exclusive or complementary. The general framework of decision emergence (Güth, 2000a) provides a remedy for some of those deficiencies. It tries to combine the most important concepts by outlining a dynamic process of generating or making choices. It relies on a "Master Module" calling up three submodules, named "New Problem Solver", "Adaptation Procedure", and "Learning Module" which can all be represented by flow charts (see Appendix).

The major purpose of the "Master Module" is to provide access to former experiences and to update the behavioral repertoire by post-decisional evaluations of decisions whenever possible. The "Master Module" calls up the "New Problem Solver" when the decision maker never has confronted an at least qualitatively similar situation before. This should be a rather rare situation at least for experienced decision makers like top managers of large enterprises. One basic idea of "New Problem Solver" is that one starts with rather simple cognitive representations and engages in more complex considerations only, e.g. by incorporating more relationships, if a bad experience would be very costly (not necessarily in monetary terms only).

These few comments should illustrate already that there is a lot of room for individual differences in behavior without even distinguishing psychological personality types. Two persons in the same position might decide differently since their experiences, their cognitive capabilities, or their subjective "costs" of a bad experience differ. In our view, most psychological types (see Brandstätter and Güth, 1998, for an attempt to account for behavioral differences by personality types) rely on qualitatively similar decision procedures, as the one outlined here, but weigh the various procedural steps differently.

The other two submodules are applied when former experiences are available. The "Learning Module" is used when the same decision task comes up repeatedly. In such a case one can improve behavior in the light of own or others' experiences via updating the behavioral repertoire (see "Master Module" in Appendix). If the former decisions are qualitatively but not quantitatively similar, "Adaptation Procedure" suggests how to adjust to such parameter changes. Enormous quantitative differences may render a situation so different that one relies on the "New Problem Solver" as in case of no qualitative resemblance.

4. Emergence of ultimatum offers

The four flow chart diagrams in Figures IV.1 to IV.4, which should be quite self-explanatory, are an attempt to apply the general frame, described above, to

the decision problem of the proposer in ultimatum bargaining. When asking for similar experiences in Figure IV.1 inexperienced proposers often seem to identify the situation with usual symmetric fair division tasks where one expects an equal split. If one denies the qualitative equivalence of such situations with the sequential process of ultimatum bargaining, the situation is often seen as rather new so that the "New Problem Solver" is called up. If qualitative resemblance is accepted, one will not necessarily translate one's former experiences when the differences in stakes, i.e. in the size of the pie, are enormous (see Footnote 3 of Figure IV.1). The essential reason for varying the size of the stakes (e.g. Güth et al., 1982) has been, for instance, the hypothesis that rejecting an unfair share of a small pie does not necessarily imply to reject the same share when the pie is much larger: Rejecting a 10 %-offer in case of a $ 100-pie means to lose $ 10; for a $ 10,000.000-pie it means to give up $ 1,000.000.

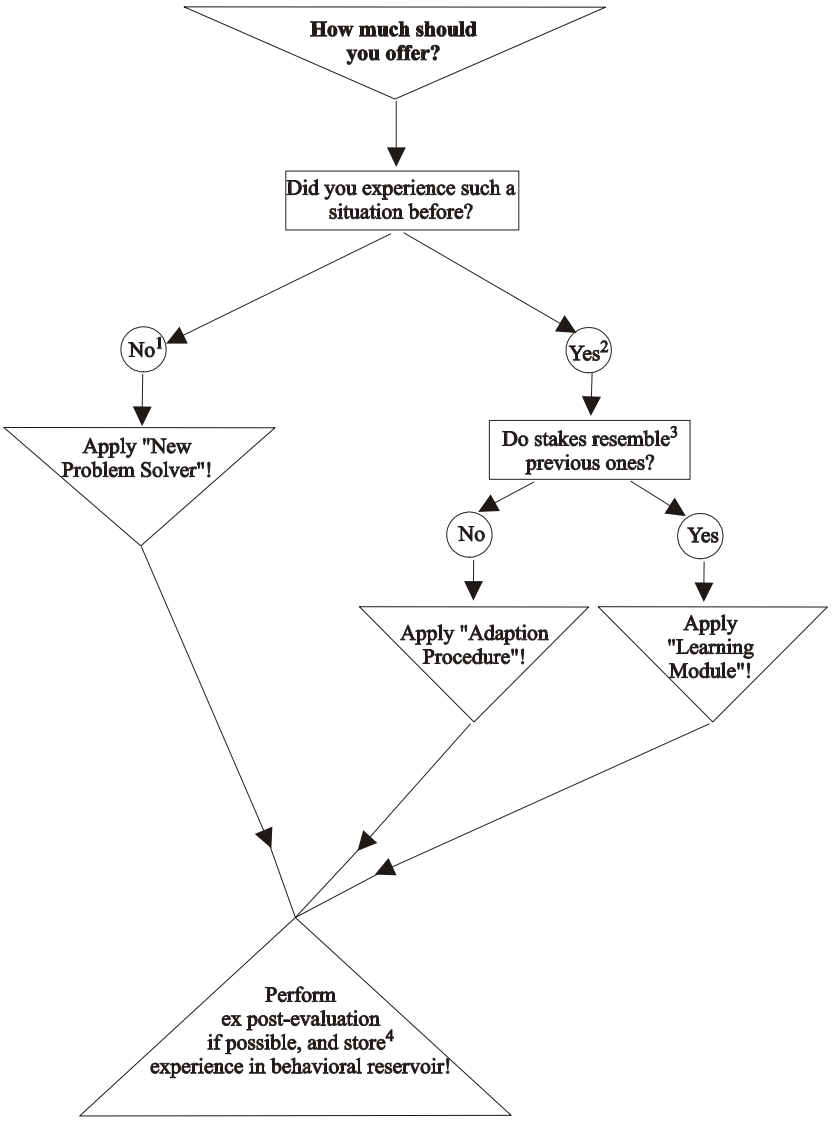

Figure IV.1: The Master Module for generating ultimatum offers

1: This depends, of course, on previous experiences. One might, for instance, not interpret the situation as symmetric.

2: Nearly everybody has once faced the problem of sharing a monetary "pie" with somebody else although with less definite rules.

3: Although this is a comparison of quantities, it will be usually performed qualitatively and often incompletely, e.g. by distinguishing minor (below $ 100), considerable (between $ 250 and $ 750), and high stakes (above $ 1,500).

4: If the offer has been accepted and the own share is satisfactory, one will consider the offer as "reasonable"; if offer was accepted, but own share is too low, one will judge the offer as "possible, but unsatisfactory"; a rejected offer will be usually regarded as "non-recommendable".

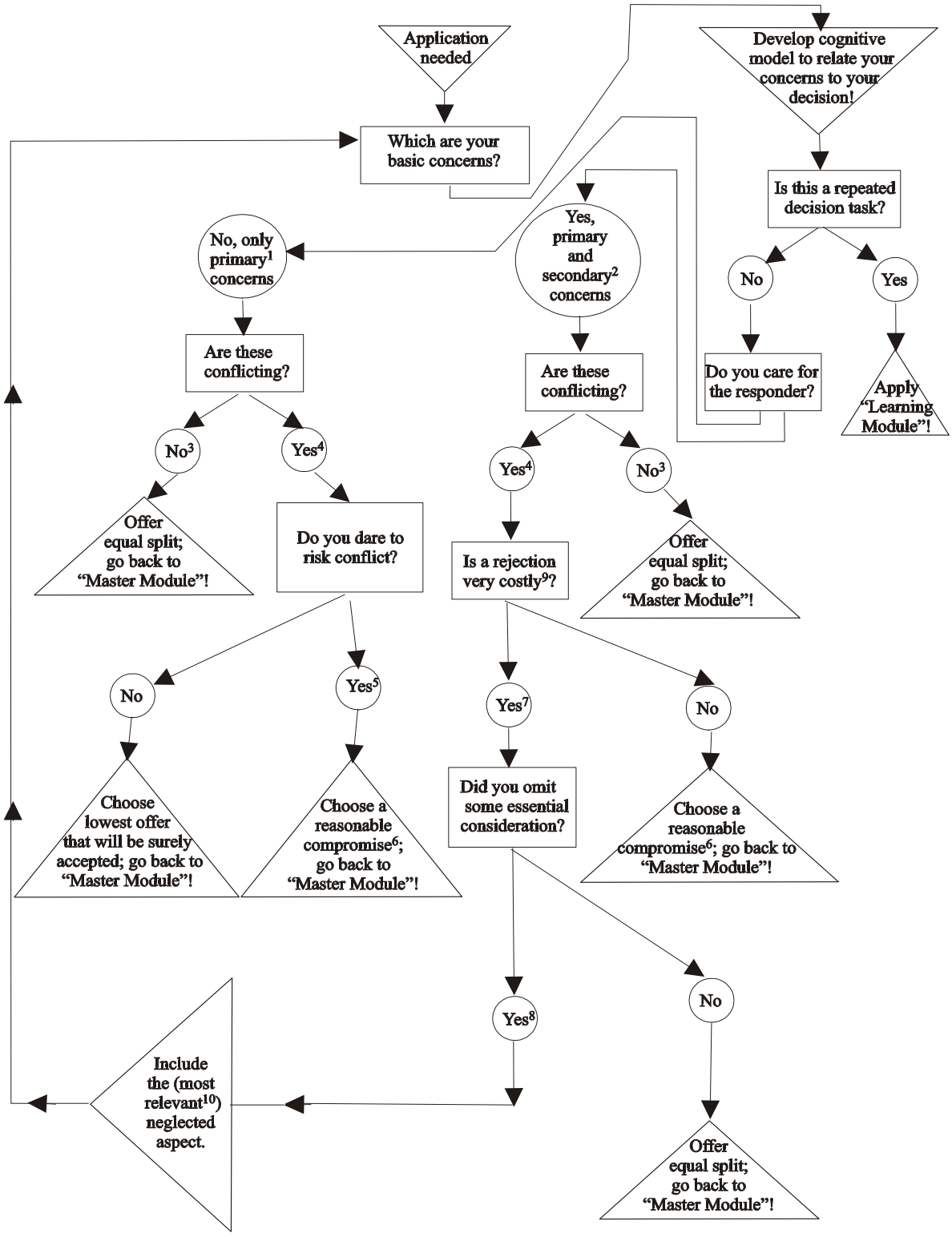

Figure IV.2: The New Problem Solver applied

1:	one's own share, probability of acceptance.
2:	Anticipating how the responder will feel after receiving an unfair offer can generate a secondary concern for the well-being of the responder.
3:	if one just focusses on an equal split.
4:	After imagining how the responder will feel acceptance of unfair offers appears dubious.
5:	possibly in form of a step function (see Figure IV.3).
6:	possibly by forming aspirations for own share and acceptance probability; aspiration adjustment if necessary (see Selten, 1998).
7:	in case of high stakes or strong fears of regret after exploiting.
8:	One might, for instance, rely on the hypothesis that responders will never hurt themselves and accept their fate as the result of an unlucky assignment.
9:	These costs include not only one's share of the pie but also the social damage.
10:	If a priority of (neglected) aspects exists, one will rely on it; otherwise the aspect is selected (more) arbitrarily.

Assume that the situation is seen as new so that the "New Problem Solver" (Figure IV.2) has to be applied by the proposer. At first, a proposer very likely will consider only his own monetary concerns as they are reflected by the two primary concerns (Footnote 1 of Figure IV.2), namely how much he claims for himself $(1 - o)$ and how he views the chances of having his offer o accepted. To assess the latter chances one will typically try to imagine how the responder would react to the various offers which one seriously considers. The simple and possibly incomplete prediction model in Figure IV.3 claims that this is done by avoiding probabilistic ideas (for a thorough discussion of the cognitive and emotional aspects leading to rejections of low offers, see Frankenfeld, 1998).

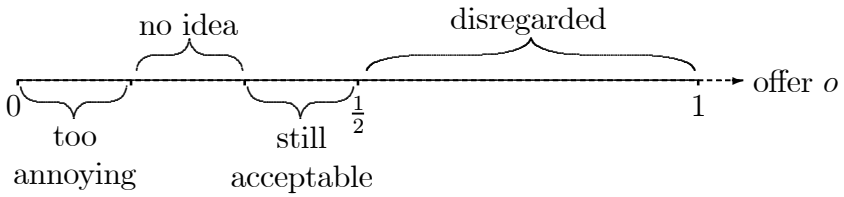

Figure IV.3: Incomplete anticipation of responder behavior

A proposer who just considers the two primary concerns will not necessarily recognize a conflict between them as long as he remains in the range "still acceptable"

of Figure IV.3. A proposer, who after anticipating responder behavior, has developed a secondary concern for the responder's well-being, will view his concerns as conflicting over the whole range $o < 1/2$ since any such offer is likely to annoy the responder.

Footnote 8 of Figure IV.2 points to an inexperienced proposer asking "why should the responder reject at all?" If he can find no reason for the responder to reject low offers and he has not developed a concern for the responder's well-being, the proposer might conclude that the range of what is "still acceptable" includes low offers, too.

Notice also the various ways in which the offer $o = 1/2$ can emerge (after the two "No[3]" and after the two "Yes[4]" in Figure IV.2). The same observations for different participants in an experiment do not imply that their decision processes are the same. This points to a weakness of many experimental studies performed by economists who, unlike in experimental psychology, do not try to detect why certain decisions are made.

The "Adaptation Procedure" (Figure IV.4) is activated when one has experienced the ultimatum game before, but with quite different stakes. If one considers these differences as inessential, one will adjust numerically, e.g. by offering a similar share as before if the former offer was accepted. Otherwise Figure IV.4 suggests ideas for a smaller pie (namely to consider more seriously the equal split offer $o = 1/2$) different from those for a larger pie where one might view the new situation as so different that one analyzes it all over again by applying the "New Problem Solver".

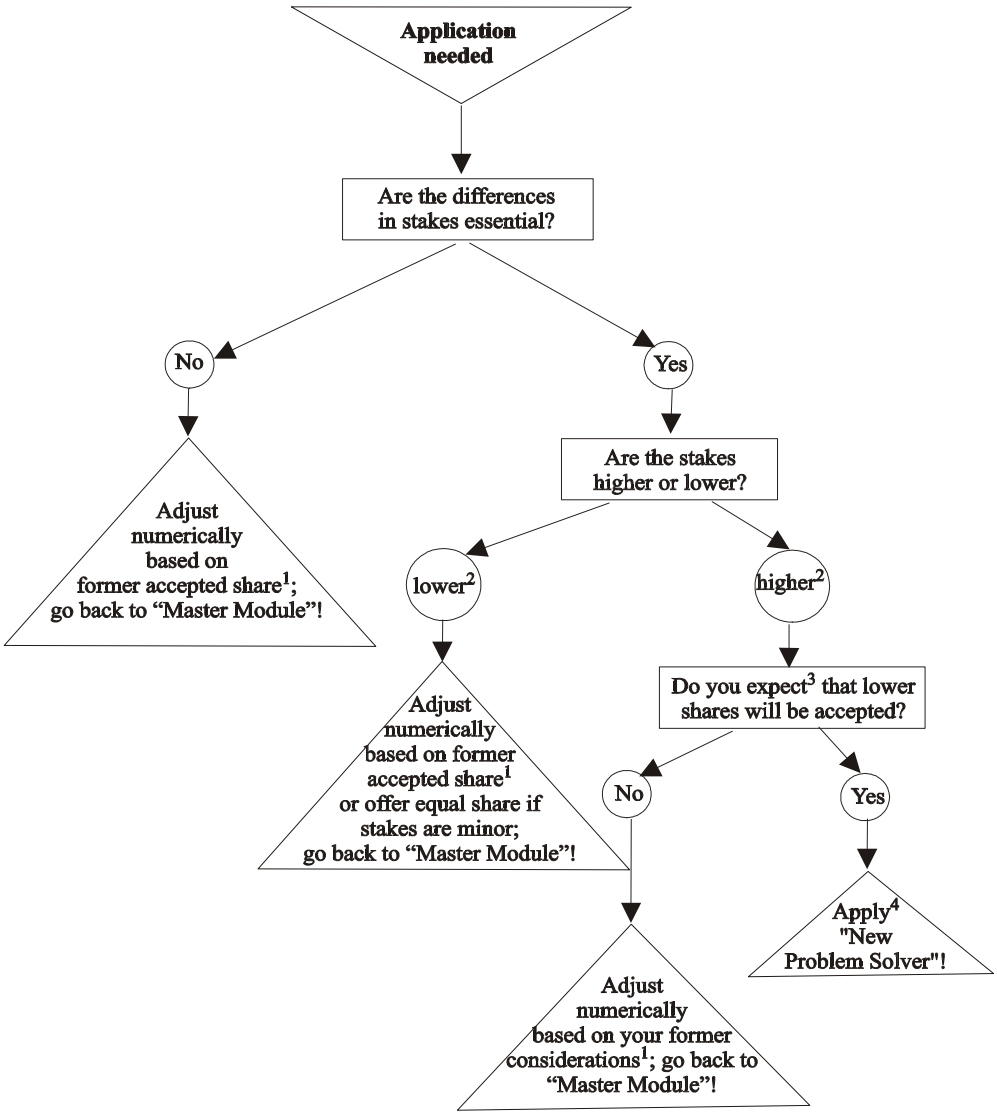

Figure IV.4: The Adaptation Procedure applied

1: possible by first computing the same share as before and then adjusting to some prominent amount of money or a prominent percentage of the pie.
2: In view of Footnote 3 of Figure IV.1 the differences are often qualitative like "less than twice", respectively "more than twice the amount".
3: This means to adjust one's imagination how the responder will feel (see Footnote 4 of Figure IV.2) in case of much higher stakes and to predict how large an offer it needs to keep him under control.
4: Essential quantitative differences can render a situation as essentially new.

If not only the ultimatum game has been experienced before but also the stakes were nearly the same, "Learning" (Figure IV.5) can take place by first relying

on formerly successful offers and then by possibly updating one's assessment of which offers are good or bad in the light of the new experiences. According to Footnote 2 of Figure IV.5 a rejection does not necessarily disqualify an offer o forever. Proposers may be aware of the considerable heterogeneity in responder behavior and might have anticipated a small chance of having a low offer rejected. If one repeatedly plays the ultimatum game with the same partner (see Footnote 3 of Figure IV.5) one might become aware of having to consider the supergame structure and to account for reputation formation although not in the formal sense of reputation equilibria (Kreps, Milgrom, Roberts, and Wilson, 1982, see for experimental evidence Slembeck, 1999, and Anderhub, Güth, and Slembeck, 1999).

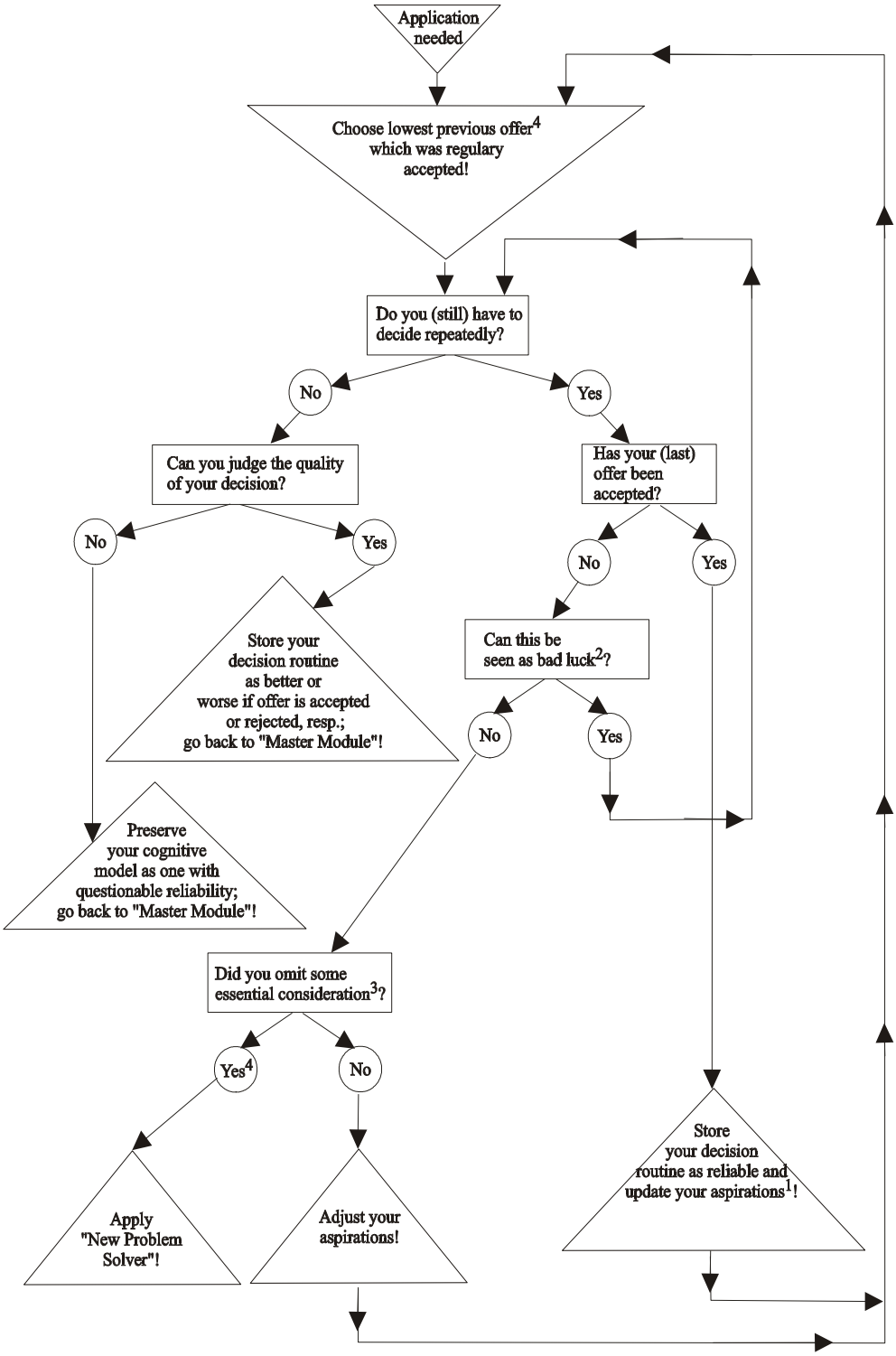

Figure IV.5: The Learning Module Applied

1:	If one has been too cautious, e.g. by offering the equal split, or if other proposers had lower offers accepted, one might want to offer less next time. Thus when the behavior and success of others can be observed, imitation (learning) is possible (see Vega-Redondo, 1997).
2:	If one is aware of responder heterogeneity, as revealed by large variances of acceptance thresholds, one has expected a rejection of a low offer with positive probability.
3:	In case of repeatedly playing with the same partner, one might become aware of the reputation idea, namely that the responder rejects in order to create the reputation of being tough. Similarly, one may want to experiment systematically with other choices to avoid sticking with inferior alternatives (see Albert et al., 2000, for an ultimatum experiment exploring such experimentation or search). Both ideas can suggest to try (even) low(er) offers.
4:	In case of an important decision, e.g. a very large pie, one might prefer to apply the "New Problem Solver" rather than to rely on a cognitive model with questionable reliability.

There are many theoretically analyzed and experimentally tested models of learning behavior. But they usually rely on a constant cognitive representation which may be more or less rudimentary like "what was good in the past will be good in the future" in reinforcement learning or "what is good for you will be good for me, too" in imitation dynamics. The "Learning Module", as specified in Figure IV.5, does not rely on such a constant cognitive model, but allows to adapt one's cognitive representation when this is suggested by former experiences. Imagine, for instance, a proposer who gets caught by the hypothesis in footnote 8 of Figure IV.2 and who nevertheless experiences that his low positive offer o is rejected. Clearly, such a proposer will have to adapt his model of responder behavior, e.g. by including emotional aspects triggered by unfair offers. The "Learning Module" is mainly an attempt to combine such cognitive updating of one's decision model with the usual adaptation of behavioral parameters, studied in the learning literature.

5. Conclusions

Many of the general ideas in section 3 can be stated much more specifically when focussing on the emergence of ultimatum offers only. Nevertheless we are still

far from offering an algorithm. But the empirical questions, which have to be answered before such an algorithm can be specified, appear to be manageable by employing psychological methods for illuminating cognitive processes.

In Figure IV.1 one essentially needs a theory of numerical resemblance (Tversky, 1977, Rubinstein, 1988). To develop such a theory one needs, of course, empirical facts. For specific situations like, for instance, auctions one can rely on previous experimental studies (see Kagel, 1995, for a survey of auction experiments). In a private value-auction one may regard nearby private values as similar or different. Here and in case of complete information, when one knows the values of all bidders, the same bids for different constellations might indicate that one views these situations as quantitatively similar. Hints when people consider two different situations as qualitatively similar or different can be obtained from experiments in which participants confront a variety of games instead of only one (see, for instance, Güth and Huck, 1997, and Suleiman, 1996, who restrict the veto right of the responder).

Modelling how proposers check their cognitive representation of the decision environment for completeness (Figure IV.2) is more demanding. According to Güth (1995) cognitive representations serve as decision generators (e.g. "Choose lowest still acceptable offer!") and decision filters which test the recommendations in the light of neglected considerations (e.g. "Do I really want to annoy the responder?"). Typical experimental procedures for observing cognitive processes are think aloud-experiments or experiments where each decision maker is represented by a team of participants whose discussions when making up their mind are recorded on audio- or video-tapes (see, for instance, Henning-Schmidt, 1999).

In Figure IV.4 the question whether the responder will accept lower shares in case of high stakes requires a cognitive representation of responder behavior that allows to check for variations in stakes. Usually a proposer will develop such a model only for the stakes at hand. Again previous studies might suggest some guidance how people react to variations of stakes. The so-called high stake-ultimatum experiments (see the survey of Roth, 1995) revealed an impressing robustness of

the typical behavior. Other studies might help, too: In ultimatum experiments with incomplete information (e.g. Mitzkewitz and Nagel, 1993) usually only the proposer knows for sure the size of the pie. This may provide some hints how and why proposers react to varying stakes. Here it will, of course, matter that the responder does not know the true size of the pie.

How people are influenced by past experiences and how present experiences change their behavioral inclinations has traditionally been discussed in the psychological learning literature (e.g. Bush and Mosteller, 1955) and more recently in experimental economics (e.g. Roth and Erev, 1995). Although no commonly accepted conclusions are in sight, one can try out many interesting, well elaborated, and at least partly successful adaptation dynamics. Notice, however, that unlike in Figure IV.5 such dynamics typically deny cognitive learning in the sense of improving one's cognitive representation, e.g. by incorporating new relationships (as possible by applying the "New Problem Solver" in Figure IV.5). Different adaptation dynamics usually rely on different information feedback which might be the essential treatment variable in an experimental study (see, for instance, Huck, Oechssler, and Normann, 1999). Whereas most theoretical studies explore adaptation dynamics in isolation, actual behavior may be shaped by several forms of adaptation, provided their informational requirements are met.

In summary the general framework of decision emergence is a stylized internal deliberation process whose basic stages (first checking for past experiences before cognitively representing and updating one's decision model, proceeding from simpler to more demanding representations only when needed etc.) are rather obvious but whose details (e.g. which adaptation dynamics describe learning) are more debatable. Hopefully one can import ideas of other research traditions, e.g. of agent based models (see, for instance, Fischer et. al., 1997, and Bates et. al., 1997) which try to illustrate which intelligence agents have to command in order to account for the typical variety in human decision behavior. One might also consult experts in order to learn how they generate their advice, respectively decision behavior. Even if this leads to biased answers, one should refer to such data (e.g. in the form of stylized facts) rather than speculate without empirical

guidance. In case of ultimatum bargaining one might ask inexperienced proposers for their mental model and compare it with those of very experienced proposers.

The advantage of relying on the general framework of decision emergence is that it imposes some discipline when formulating ideas about how decisions are made. Actually some aspects (regarding adaptation and learning) of the general framework have been changed after trying to apply them to the emergence of ultimatum offers. Further applications might bring about further changes where one, of course, should consider whether and how such alterations question the explanation of the previously considered decision problems. Hopefully other researchers will rely on similar ideas how boundedly rational decision makers generate their choices.

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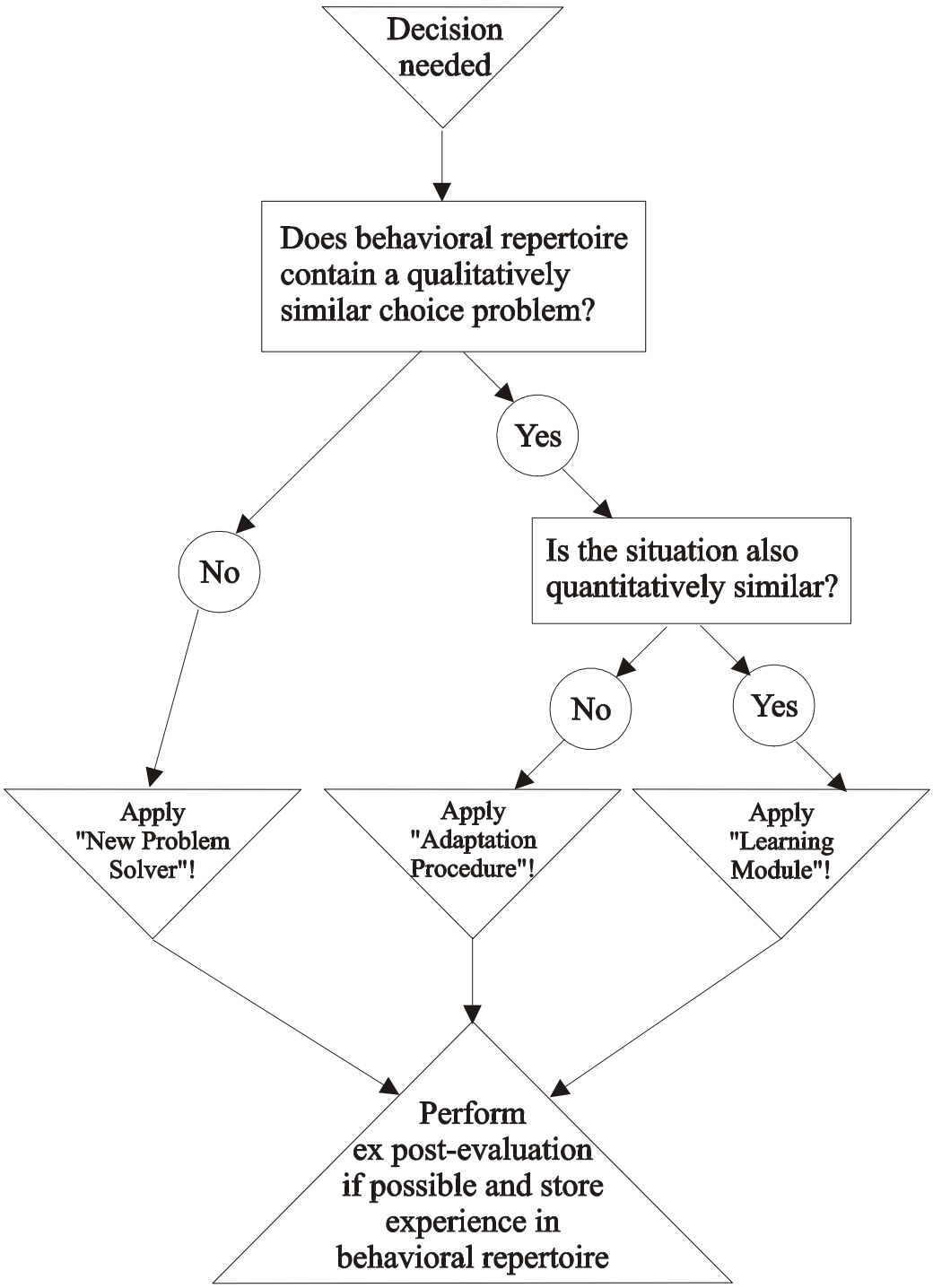
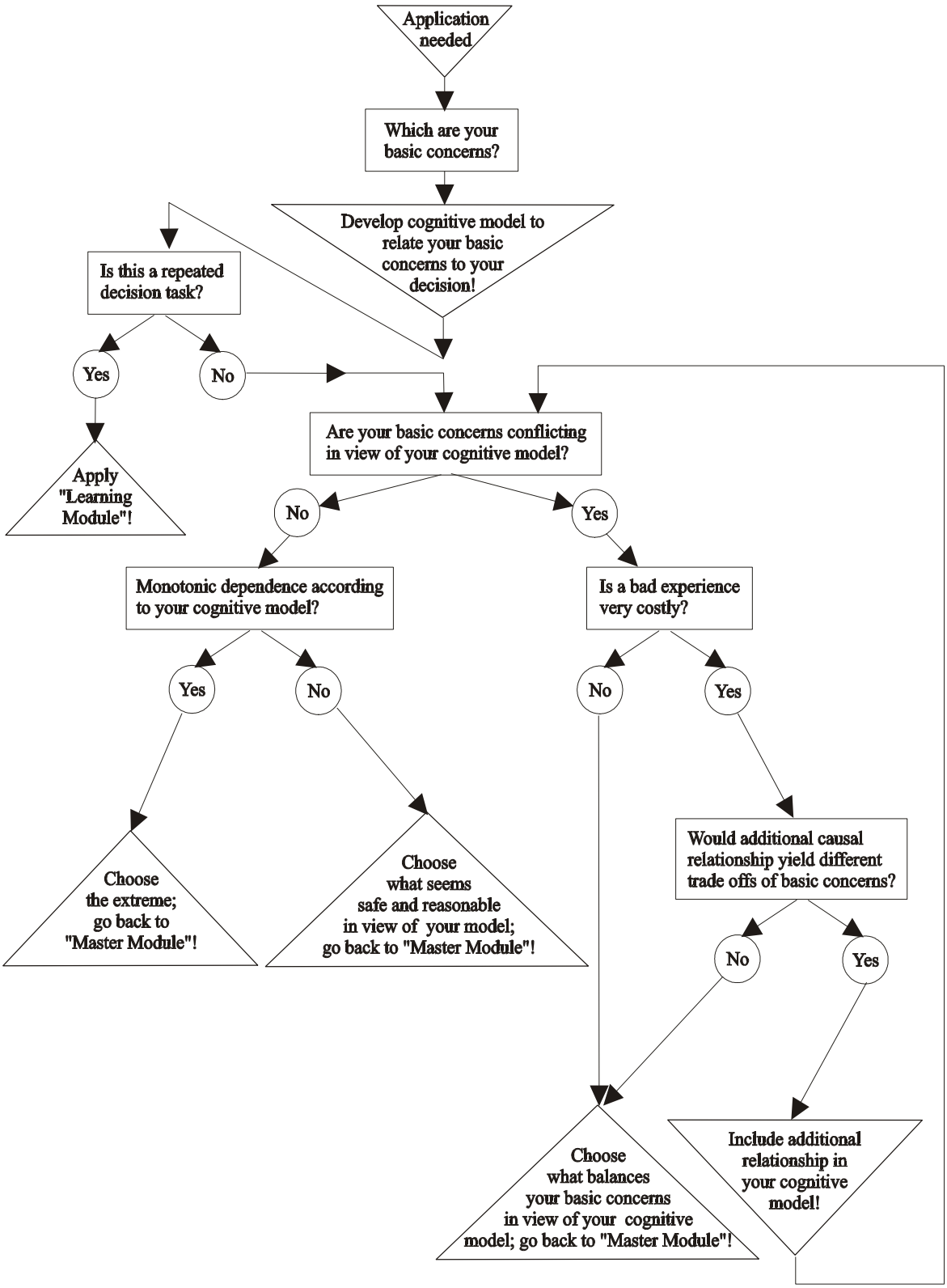
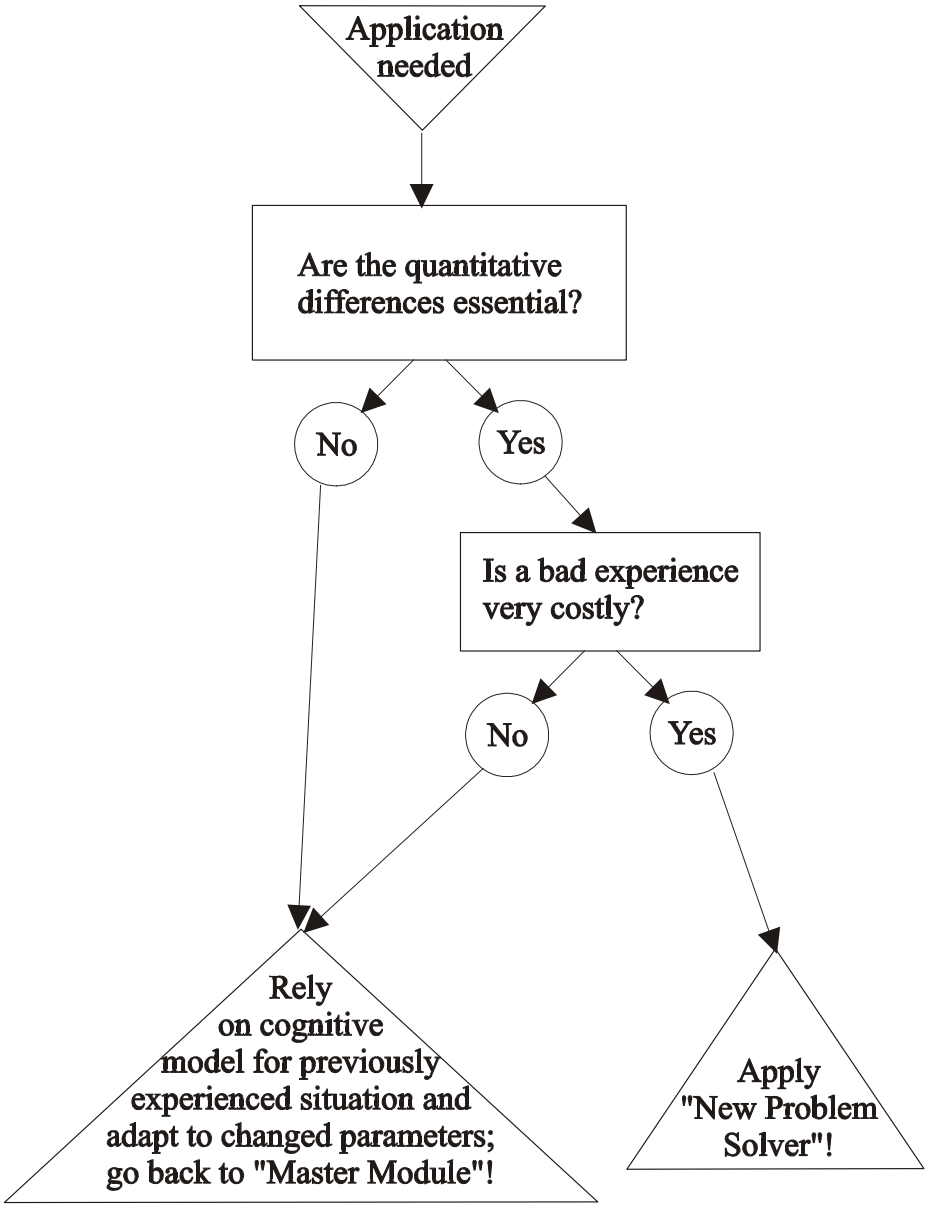
Appendix:

An outline how to model boundedly rational decision emergence

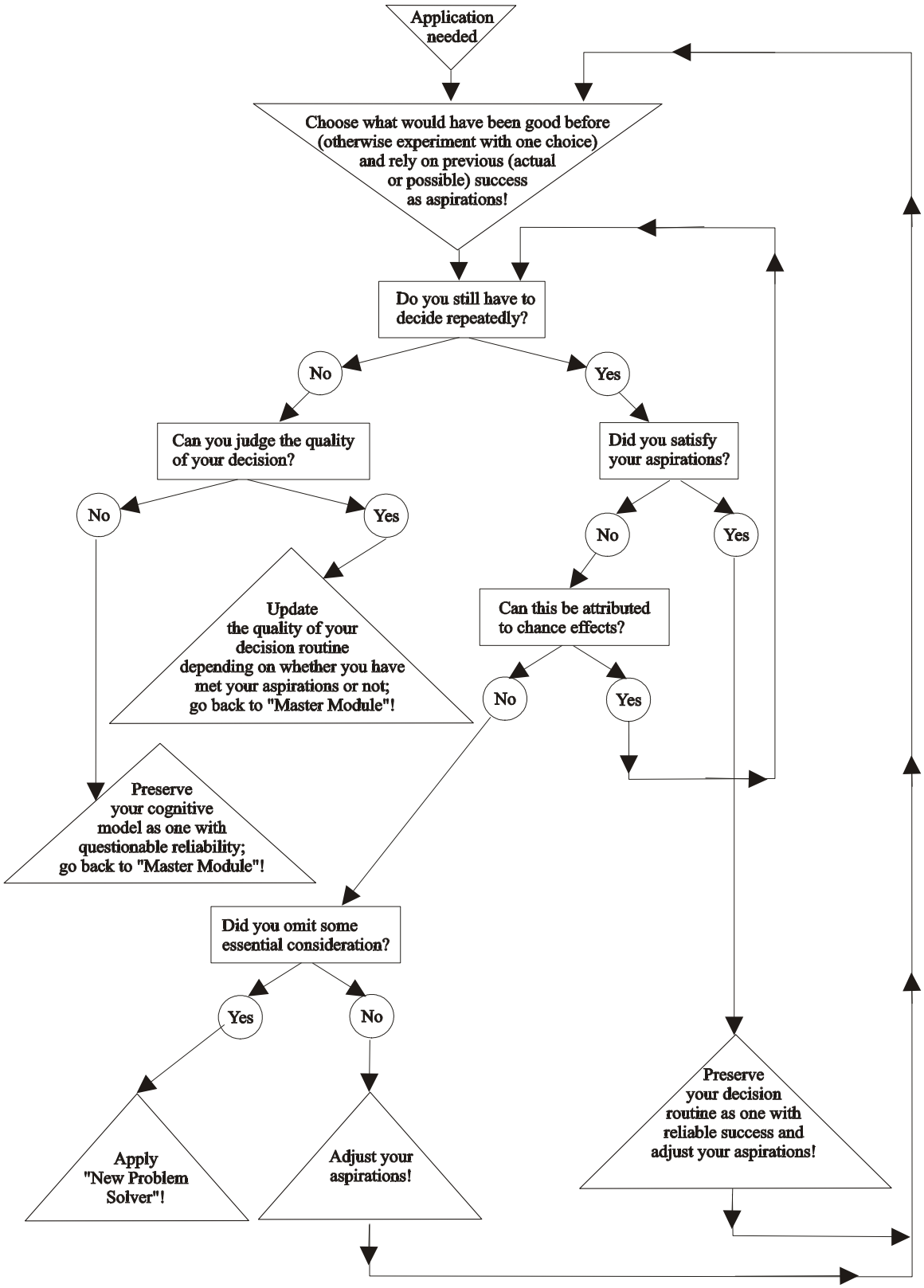


The Master Module


Application needed
Which are your basic concerns?
Develop cognitive model to relate your basic concerns to your decision!
Is this a repeated decision task?
Yes
No
Apply "Learning Module"!
Are your basic concerns conflicting in view of your cognitive model?
No
Yes
Monotonic dependence according to your cognitive model?
Is a bad experience very costly?
Yes
No
No
Yes
Choose the extreme; go back to "Master Module"!
Choose what seems safe and reasonable in view of your model; go back to "Master Module"!
Would additional causal relationship yield different trade offs of basic concerns?
No
Yes
Choose what balances your basic concerns in view of your cognitive model; go back to "Master Module"!
Include additional relationship in your cognitive model!



The Adaptation Procedure



The Learning Module